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THE AGRICULTURAL COLLEGE

EXTENSION BULLETIN

VOLUME IX MARCH, 1914 No. 7

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CLOVER

BY CLARK S. WHEELER
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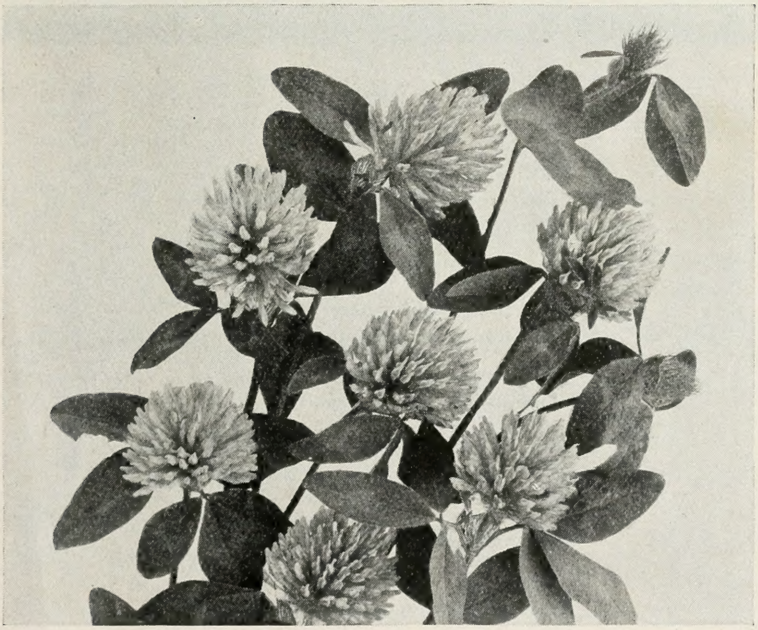
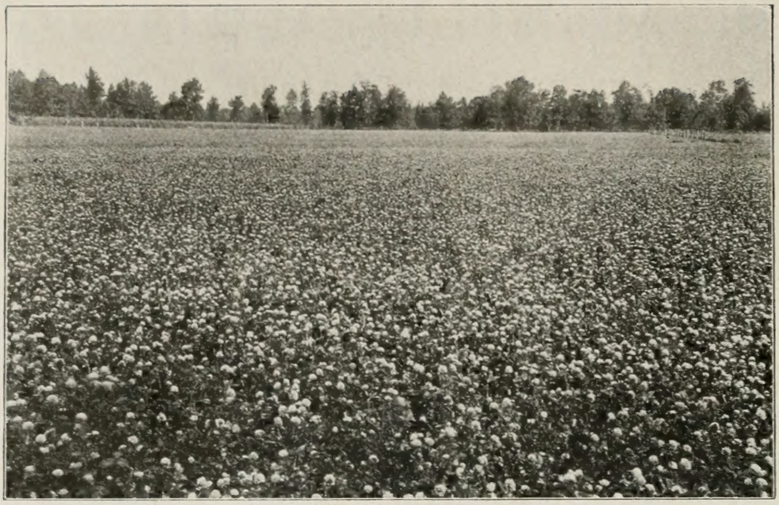


"Comrade of wind, beloved by sun,
Kissed by the dewdrops, one by one."

PUBLISHED MONTHLY BY THE OHIO STATE UNIVERSITY
COLUMBUS

Entered as Second-Class Matter, November 17, 1905, at the Post Office at Columbus, Ohio, under act of Congress, July 16, 1894



CLOVERS

The clovers have no time to play;
They feed the cows, and make the hay,

And trim the lawns, and help the bees,
Until the sun sinks through the trees.

And then they lay aside their cares,
And fold their hands to say their prayers,

And drop their tired little heads,
And go to sleep in clover beds.

Then when the day dawns clear and blue
They wake and wash their hands in dew;

And as the sun climbs up the sky,
They hold them up and let them dry;

And then to work the whole long day;
For clovers have no time to play.

—*Helen Leeming Jelliffe*

This bulletin may be secured by addressing A. B. Graham, Supt. Agricultural Extension Department, Ohio State University, Columbus.

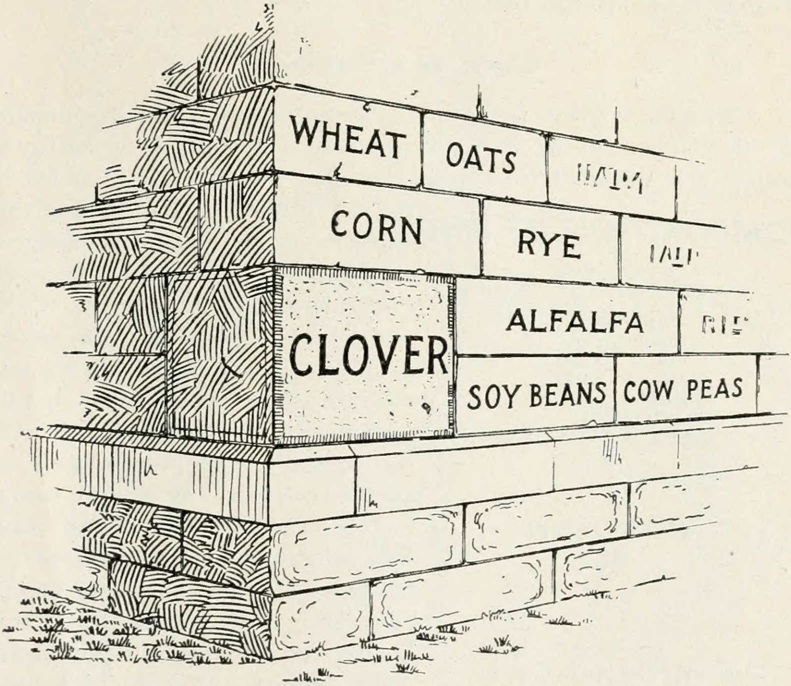
CLOVER

CLARK S. WHEELER

MEDIUM RED

Clover is the corner stone of Ohio Agriculture. Beside it lie alfalfa, soy beans, and cowpeas. Resting above and solidly supported upon it are corn, wheat, oats, and timothy. Next come livestock, dairying, and horticulture. And so rises the whole structure of the farming business. Yet underneath all and indispensable is the clover plant.

The important position which clover occupies in the farming business is due primarily to the fact that its culture increases the yield of succeeding crops. One need not be very well informed on farm practise to know that "a piece of clover sod to turn under" is a distinct asset which may be "cashed" in the form of corn, potatoes, or tobacco. Corn, potatoes, and tobacco are for this reason sometimes referred to as "money crops", but as we shall see later, they only half deserve the title since the source of their large yield may be traced to the clover which preceded them in the rotation and which is after all the real money-producing crop.

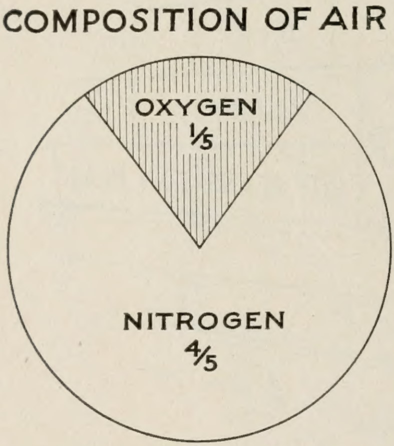


Clover is the corner stone of Ohio Agriculture

These so-called "money crops", in common with other plants, live on thirteen different substances. Ten of the thirteen "elements of fertility", as they are called, are usually present in sufficient quantity. Three of the elements,—nitrogen, potassium, and phosphorus—are frequently present in too small quantity for the growth of the largest crops. Of the three, nitrogen is the one which must be supplied most often, because it is most easily lost from the soil. If nitrogen be supplied by the application of commercial fertilizers, it is found to cost twice as much as phosphorus and four times as much as potassium. Nitrogen can be supplied in the form of barnyard manure, but the large quantity of manure which would be necessary to supply all the nitrogen is seldom available.

Clover as a Fertilizer

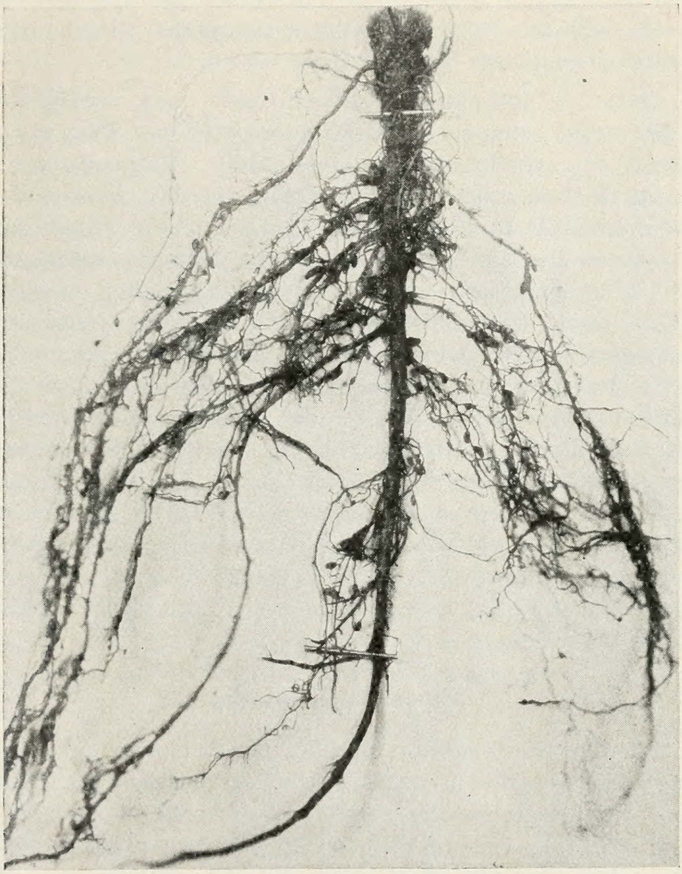
In view of the expense and difficulty of supplying large quantities of nitrogen in the form of commercial fertilizers or barnyard manure, it is fortunate for us that nitrogen from the air is added to the soil by the growing clover plant. The air, being four-fifths nitrogen, contains above each acre thirty-seven thousand tons of this element. Curiously enough the part of the clover plant above ground and wholly surrounded by air has no share in this trapping of the free nitrogen. On the contrary, the process goes on among the roots. A careful examination of a vigorous clover plant will usually show the presence on the roots of numerous little bumps or knobs called "nodules". These nodules are the homes of tiny plants called bacteria. The bacteria have the power of taking nitrogen from the air which penetrates the soil and combining it so as to form compounds which the plant can use. In return for this service the plant furnishes the bacteria with part of their food, and thus this very useful partnership goes on. In this connection it should be noted that only air which enters the soil and comes in contact with the roots can furnish nitrogen. Added force is thus given to arguments in favor of such tillage as will leave the soil loose and friable and in favor of tile drains on account of their tendency to ventilate the soil.


COMPOSITION OF AIR

Clover takes nitrogen from the air

Clover in the Rotation

Large yields of other crops are grown after clover not alone because of the nitrogen which is added to the soil. Other factors of soil fertility are improved and hindrances to the later crops are removed. Some of the characteristics of clover make it especially adapted to the rotation. It usually completes its growth in two years, and can be seeded in the same season in which another full crop is harvested.



Red clover roots showing nodules

These facts are advantages where it is desired to grow corn, potatoes, or tobacco as often as possible. Clover develops a deep and extensive root system which collects plant food from soil not reached by many crops. Part of this fertility remains stored in the stubble and upper roots when the hay and seed are removed and still more is deposited in the aftergrowth produced during the fall. When clover sod is plowed under, the roots, stubble, and aftergrowth total a large amount of organic matter, the decay of which renders the phosphorus and potassium available. The value of the humus formed from organic matter left by clover is rather generally underestimated. As a result, farmers are less insistent upon a large and regular seeding than they should be. Within a dozen years, virgin soil in some parts of Ohio has shown a marked decrease in yielding power. It is not thinkable that the plant food in heavy timber land stored through ages has been so quickly removed. The only explanation is that the humus supply has been depleted.

Clover is not closely related to corn, oats, wheat, timothy, and other crops commonly found in the rotation. They are grasses and clover is a member of the legume family. Consequently, insects which attack these other crops are often noticeably checked when the land is given over to clover. For the same reason, fungus and bacterial diseases are less likely to reduce the yield of crops grown after clover. Whether it be by adding nitrogen, bringing up plant food from the subsoil, furnishing humus, or starving out insect pests and diseases, clover is always increasing the yield of the other crops in the rotation. Just how much each of these helps no one can tell, but that taken together they exert a strong influence can be proved. The Illinois Experiment Station for thirty years conducted a comparison of corn growing to show the value of clover. During that period the corn grown after corn continuously yielded twenty-five bushels per acre. Where corn and oats were alternated, the corn grown every second year averaged forty-three bushels. Where corn, oats, and clover were grown, the corn coming every third year averaged fifty-nine bushels per acre.

Clover and Timothy

Though the important position which clover occupies in the farming business is due primarily to the fact that growing it increases the yield of other crops; nevertheless, clover holds this position on account of secondary benefits also, which are very considerable. This second group of benefits which result from the growing of clover has to do with its relation to timothy. Timothy hay and oats have long been considered the one staple feed for horses. They have been considered especially essential during warm weather. Unfortunately, they are considerably higher priced than clover and corn, a roughage and a grain frequently substituted. The ten-year average price of oats is about one half cent more per pound than corn. Timothy contains a high per cent of carbohydrates and fats, and oats a high per cent of protein. On the other hand, clover also contains a high per cent of protein while corn is well supplied with the fat equivalents. It would seem then that mixed hay and corn might be substituted for timothy and oats. The Ohio Experiment Station has proved this to be the case with mature geldings. Even the spirit of the horses in hot weather was observed to suffer no depressing effects. With these facts in mind, the farmer may either produce a smaller proportion of timothy which adds no nitrogen, and a larger proportion of clover; or, he may sell his timothy and oats, feeding the cheaper but equally valuable clover and corn. Clover hay has always been a highly esteemed feed for other kinds of stock.

A second interesting relation exists between clover and timothy. As already stated, it is well known that a large corn yield can be secured after turning under a clover sod. It is equally well known that a much smaller crop of corn is secured after timothy. Many observing persons have noticed that after a sod containing a small mixture of clover, much better results are obtained than the small amount of clover would seem to account for. At the Cornell (New York) experiment station plots of pure timothy, and timothy and clover together, were grown side by side. It was found that timothy straws and heads picked out of the mixed hay contained more nitrogen than stems taken from the pure timothy hay. This difference amounted to 21.3 pounds of nitrogen or 133 pounds of protein, per ton. Apparently then, the greater fertility present after mixed meadows where the amount of clover is small, than after pure timothy, is due to an increased amount of nitrogen in the timothy roots and stubble as well as that in the clover. These facts constitute a strong argument for including some clover in all meadow seedings. Especially is this practise advisable in view of the previously stated value of mixed hay for feed.

The Soil

On account of its many useful characteristics, clover should be widely grown. Fortunately, soil conditions are such as to make its culture practicable on most farms in this state. Land which will grow good corn will usually grow good clover. Land in Ohio which will not grow good corn generally needs clover and, by the exercise of some pains, can frequently be made to grow it. In preparing land to grow clover, primary consideration should be given to the drainage. Unless well underlaid with a porous subsoil, most soils will be improved by the laying of tile. An increased feeding area will thus be afforded the numerous long roots, and an excess of moisture will not prevent the nitrogen-fixing bacteria from acting.

Wet soils are unfavorable to the growth of clover from the additional fact that they are likely to be "sour" or acid. Sometimes knolls and hill land are also affected in this way. The presence of sorrel is an indication of a "sour" soil though it will persist after the soil has been made sweet unless crowded out by some cultivated plant. Acidity in the soil is neutralized by the application of lime. One ton of quicklime or two tons of ground limestone per acre is commonly applied, the choice between the two forms depending upon their cost delivered.

Clover Seed

It is a waste of effort to provide a rich, sweet soil unless it be sown with pure vigorous seed. The surest and cheapest way to get the right kind of seed is to raise it, but on account of the seeming uncertainty of clover seed production this is not always possible. Equally desirable seed may then be secured from a reliable neighbor. When this source also fails, the purchaser is forced into the open market. Here he may find almost any quality of clover seed. As he knows nothing about the history of the seed offered for sale, he must guard against several undesirable characteristics. A great deal of seed is on the market which has been purposely adulterated with cheaper seeds. Weed seeds are likely to be present in all clover seed in greater or less proportion. If the seeds are those of weeds not common where the clover is to be sown, the harm is much greater; and if they represent especially noxious weeds, they may cause much labor and expense. Inasmuch as the seed is bought for the purpose of producing a crop, it is important that it should grow. Hard seed, very old seed and immature and shriveled seed, none of which will grow, are often present. Even after clover seed grows it may be of comparatively little value. This happens when seed is brought from a less severe climate and does not produce strong plants. One source of trouble is found in the clover seed from Europe. Notwithstanding the fact that we export some good quality seed, large quantities of

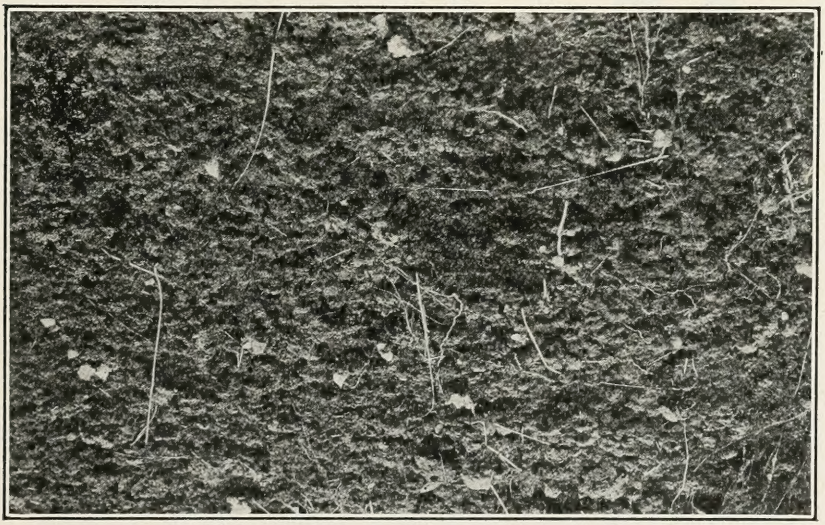
The homemade dinner plate seed tester

small weedy seed containing clover dodder are imported to be sold at a lower price.

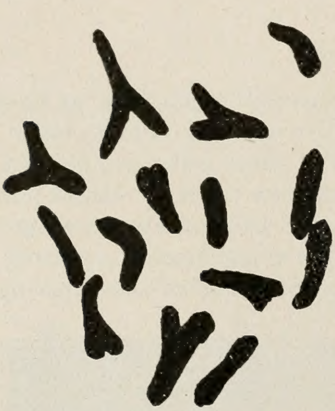
Any of the faults mentioned may apply to a given sample of clover seed offered for sale. In the case of fertilizers and feed stuffs official inspection provides for the detection of fraud, but in farm seeds the matter is left to the purchaser. Fortunately the average person can, with a little pains, learn to reject markedly inferior seed. In examining a sample of clover seed previous to purchasing, the buyer should seek to determine three things: (1) what proportion of the sample is the kind of seed wanted, (2) what proportion of the seed wanted will grow, and (3) what is the character of that part of the sample not wanted. An examination of clover seed along these lines cannot fail to be interesting to the careful farmer and may be made a useful exercise in the rural schools.

Testing the Seed

In order to determine what proportion of the sample is the kind of seed wanted, a small magnifier costing fifty or sixty cents is needed. Spread a small quantity of seed on a sheet of white paper and by comparison with pictures or a pure sample, separate the seed wanted into a pile. For accurate results this pile should be weighed and its weight expressed as a per cent of the weight of the whole amount separated. In the absence of balances this per cent may be estimated by comparing



Close view of soil honey-combed by frost, and in proper condition for seeding. United States Department of Agriculture. (Farmers Bulletin 455) the pile of seed wanted with the pile of material not wanted. The seed wanted is now tested to see what proportion of it will grow. Take a definite number of seeds without reference to size or appearance. The simple dinner plate germinator shown in the illustration may be used. Place two thicknesses of heavy flannel cloth between the plates and keep it moist. In ordinary room temperature the sprouts will appear in four or five days. Seeds that do not sprout in two or three days more cannot be depended upon to grow in the soil that season. Some of the seeds which do not grow if examined closely will be found quite solid. These are the so-called "hard" seeds which may amount to from a third to a half of the sample in seed less than a year old. The proportion is smaller in older seed. The germination period having been completed, count the number of sprouts and express the result as a per cent of the number of seeds placed in the germinator. To get the per cent of vigorous pure seed, multiply this per cent by the per cent of pure seed previously obtained. This is the part of the sample for which we are paying, and if it be but a small part we are making a poor bargain. The first two parts of the test are comparatively easy. The third step, determining the character of the material not wanted, can be accomplished only after study and practise. Many of the weed seeds found in clover seed are practically harmless. They may be added to the dirt and dead seed simply as material which lessens the amount of good seed in a bushel. Some of the weed seeds are distinctly harmful and, being similar in appearance to many other small seeds, require the practised eye for their detection.


Bacteria from the nodules of a clover root. Magnified a good many thousand times.

Sowing the Seed

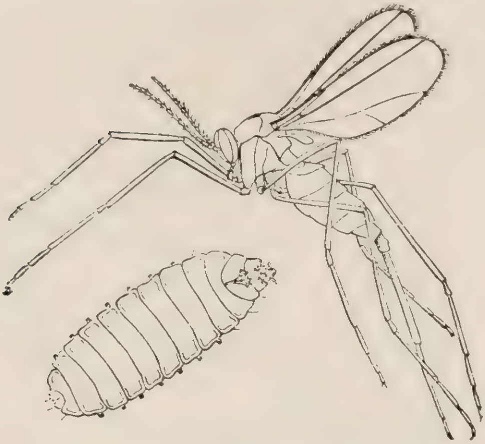
With good seed and a well-drained, sweet soil provided, we are ready to consider the time and manner of sowing the seed. The majority of farmers thruout the state get better results by seeding clover in wheat than in any other way. As to the time of scattering the seed, practise varies greatly. A general custom is to sow when the ground is "honeycombed" or "crackled" in the hope that the seed will fall into the crevices and be covered. Preference is given to the honeycombed or dry, frozen condition which is likely to occur early in

March. The dry, crackled condition develops later and may be considered a second choice. Care should be taken to avoid the seeding on a moist, sticky surface which will prevent the seed from getting into the crevices and being covered. If the seed is sowed on dry, frozen or dry, crackled ground, especially if the soil is well supplied with organic matter, a "catch" of clover may be expected. In many seasons it is not possible to accomplish seeding on a honeycombed or crackled surface Furthermore, the very fields which most need the benefits of clover are likely to be so deficient in humus as to make it difficult for the young plants to get a start. For such seasons and soils, harrowing improves the chances of getting a stand. Preferably, the ground is harrowed both before and after seeding. This treatment necessitates delaying the seeding until at least the surface is dried. Consequently, men and teams must be used at a time when they are needed for other crops. However, the clover is usually worth the effort. Harrowing is not found to injure the wheat and what timothy it destroys can well be sacrificed in favor of clover.

Oats are frequently used as a nurse crop for clover with good results. The chief objection to this method of seeding is due to the dense shade which the oats form with their broad leaves. It can be partly removed by using only a light seeding of perhaps four or five pecks per acre. The practise of seeding in the summer without a nurse crop is growing in popularity. For this purpose the seed bed should be carefully prepared. Independent of the method of seeding, four or five quarts of seed are used, care being exercised to be sure that all of the ground is covered.

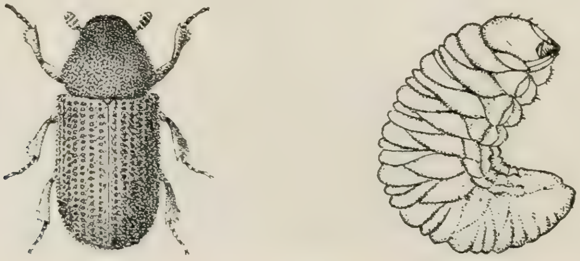
Bottles containing pure cultures for use with legumes

It is possible for clover to be so seeded as to produce a full crop and yet do the soil very little good. This occurs when no nitrogen-fixing bacteria are in the soil and, consequently no nodules form on the roots. On account of the fact that clover has been grown for a long time in this section, such a condition is unusual. When it does occur, the bacteria may be supplied artificially by "inoculating" the soil. The most convenient and certain method of inoculating a field is by the use of soil from another field which is growing clover plants with plenty of nodules on their roots. The soil transferred is broadcasted at the rate of a few hundred pounds per acre. It should be harrowed under without being exposed to bright sunlight. In case soil which is free from noxious weeds and insect pests cannot be secured, pure cultures may be used. Bottles containing pure cultures of bacteria for clover may be secured from the United States Department of Agriculture and from private companies. The culture is diluted and sprinkled on the seed a day or-two before sowing. The seed must not be exposed to sunlight.



Clover flower midge, maggot and adult forms

With all that has been said about the importance of clover and the prevalence of poor seed on the market, it is natural to find that good seed sells for a high price and is therefore well worth raising. As a matter of fact, the production of seed is attended with the greatest uncertainty, so that farmers consider a crop of seed as a piece of good luck and usually wonder how it happened. Perhaps the number



Adult

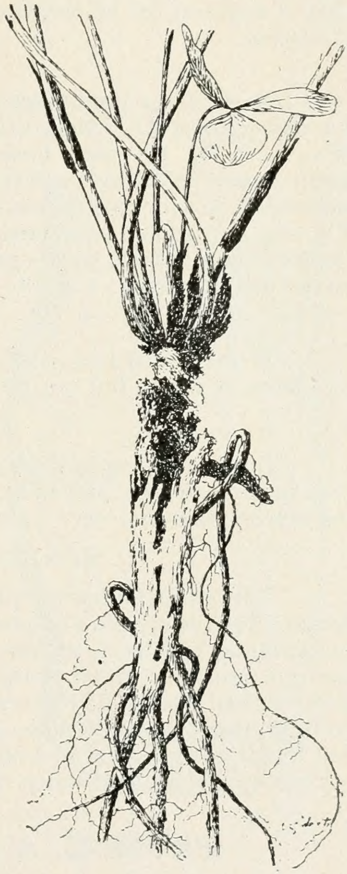
Grub

Clover root borer

of bumble bees, which are essential to pollination, exerts some influence. Yet be there any number of bumble bees, the seed may entirely fail to develop, due to another cause.

The Clover Flower Midge

The real hindrance to clover seed production is the clover flower midge. The maggots of this insect are found in the clover blossom where they destroy the ovary in each floret before it can be fertilized and develop a seed. Two generations of the maggots appear each season with the two blooming periods of the clover. To get rid of the midge is impossible for the individual farmer, because the adult which is a fly comes in from neighboring fields. Control depends upon getting the second crop of blossoms, which are to develop the seed, to appear either before or after the second generation of maggots. This is best accomplished by re moving the first crop before it would naturally be cut for hay. Either pasture until early in June or cut as hay when about half of the blossoms are open. This plan will cause the seed crop to develop early and get so far along by the time the second maggots appear that it will not be damaged by them. By this plan, the hay crop is partly given up in favor of the seed crop and usually with profit. In order to save the hay crop, some farmers delay the second crop of blossoms until after the second generation of maggots. This they accomplish by cutting over the field twice or by pasturing late. Aside from the danger of frost, this plan has the objection that before the seed crop can be harvested the plants are likely to be destroyed by the clover root borers. The grub of this insect eats out of the center of the roots during the second season. As the summer progresses, its damage becomes more apparent until by late August many plants are dead.



Clover root damaged by borers

Where the borer becomes especially bad, the seed crop is abandoned and the field plowed immediately after the hay is harvested. For this remedy to be effective, it must be practised by an entire neighborhood.

MAMMOTH

Mammoth clover is a larger form of red clover and shares with Medium red the botanical name *Trifolium pratense*. It blossoms later than its close relative and produces but one crop in a season. On account of the great bulk of green plant, it is a favorite to plow under on poor soils. Where grown for this purpose, it is frequently rolled in mid season and later cut for seed. The seed crop is made surer than that of medium red by the late blossoming and consequent avoidance of insects.

ALSIKE

Most of the statements made in regard to red clover hold good for alsike clover, (*Trifolium hybridum*). This species may be readily recognized by the pink blossoms. It is a perennial and somewhat hardier than red clover. Wet ground and soil lacking in humus may sometimes be successfully seeded to alsike though red clover has failed. The size and value of the crop however is not so great. Where conditions are unfavorable to the growth of red clover, alsike may well be mixed with the seed, 2 or 3℔. being thus added.

WHITE

White clover is a small species frequently included in pasture and lawn mixtures but not grown alone extensively in this state.

CRIMSON

Crimson clover is largely grown for green manure and as a cover crop in the southern and eastern parts of the United States. Its flaming scarlet blossoms are a sight not often seen in Ohio.

MORE ABOUT CLOVER

This short bulletin is published to meet a constant and growing demand for the simple and most important facts about clover. In its preparation, the work of the Ohio Experiment Station, other state stations, and the United States Department of Agriculture have been freely drawn upon. If the reader is aroused to a study of the subject, he is advised to consult these sources of information. A list of books and bulletins on Clover and other legumes may be secured by writing to the Ohio State University, Agricultural Extension Department.

PRUNING, A NATURAL PROCESS

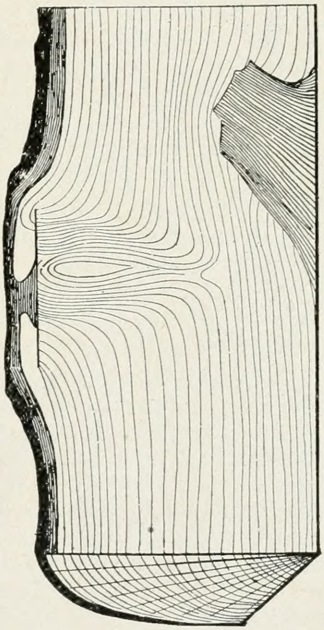
By H. E. Eswine

It sometimes happens that persons who do not favor pruning fruit and other trees will justify their position by asserting that Nature does not prune and therefore the practise is an unnatural one, not calculated to prove of ultimate worth to the tree. Such persons are mistaken in their argument for Nature is a persistent pruner. There is an abundance of evidence in support of this position too plainly written to be overlooked or misinterpreted. One has only to walk through the woods after a snowfall to see one proof. The surface of the snow will be covered with small twigs, branches, and even large limbs. These would have escaped our notice, perhaps, at any other time.

Notice how tall trees in hollows will sometimes grow. There may be no limbs for many feet above the ground. Nevertheless, if we were to split the trunk of one of these trees, the knot left by the limbs pruned off years ago could be seen, regardless of the fact that there were no indications of knots on the outside of the trunk of the tree. Knot holes in the trunk of a tree and most of the knots found in boards are evidence of Nature's pruning.

Nature's Tools

What are the tools that Nature uses to do her pruning and how and why does she use them? Shade is Nature's great pruning knife. She has some other ways of ridding trees of superfluous limbs that will be mentioned later on. Some of these ways are peculiar to certain kinds of trees. The one great object that Nature has is to thin out the branches.



Section of trunk of tree, showing wounds properly healed over (After Hartig)

Trees growing closely together in the forest have no limbs except near the top. The same kind of a tree growing out in the open would have limbs almost to the ground. Why is this? When trees grow close together as they do under proper forest conditions, there is lively competition among them for moisture, air, and light Each tree wants to expose to the air and light just as much leaf surface as possible. Because of crowding, only the upward branches can develop freely. The lower branches fail to perform their function because of shade, so nature gets rid of them. She does this in the following manner; as the lower limbs become shaded, they die. The trunk of the tree in time entirely rids itself of the branches. When the branch dies, the annual layer of wood continues to be formed around the point of connection with the trunk. This ultimately forms a collar which so tightly grips the dead limb that in time the wind either breaks it off or it falls of its own weight. After a while, if all goes well, the hole closes over and no exterior evidence of the limb remains. Ofttimes the new wood does not grow over before the dead limb begins to rot. This rot extends into the trunk until eventually it attacks the whole interior of the tree, and in time only the shell remains.

Healing the Wound

Orchardists and foresters aid Nature in speedily healing the wound by cutting off the limb just as close to the trunk as possible. The longer the stub that is left, the longer the time it will take to heal, and the more chances there will be for decay to get a foothold. If a stub is left it must die, for there are no twigs with leaves on them to draw up plant food. It is well to remember that while leaves can draw up plant food, they cannot push it up.

Some trees shed small branches in the same way that leaves are shed. A corky layer develops at the base of the twig. Later the twig breaks off at this point either because of its own weight or because the wind breaks it off. The exposed portion of the branch at the point where the twig was attached is covered with a thin, corky layer. This keeps out water and germs of decay. Thus, it is seen that Nature protects even the smallest open wounds. Among the trees that resort to this method of freeing themselves of surplus branches are the cottonwoods, white elm, and some oaks.

The willows have their own peculiar method of cutting off branches. A brittle zone about a half-inch in length is found near the base of the twig. This becomes so brittle that a mere touch or a light breeze is enough to break it off. The remainder of the twig will be found quite tough. A walk underneath a willow tree after a wind storm or, better still, after a fall of sleet will reveal to what a great extent Nature uses this method.

Trees and shrubs which do not rid themselves of extra branches in any of the above ways form cleavage planes or points of easy division at each node or joint toward the end of the twig. The elm uses this method. A cast-off twig of this tree will usually break up into as many pieces as there are years of growth.

Valuable and interesting lessons in pruning can be learned by observing Nature's way and method of procedure. Here are a few. Can you think of any others? In an orchard that has not been pruned for several years, it will be found that the live wood is in the top, while many of the lower and interior limbs are dead. This suggests that some limbs should have been cut off, not necessarily the lower ones, however. They became too much shaded and died. Had some of the limbs in the top of the tree been cut out, would the lower limbs have died? Self pruning trees shed branches every year. From this we reason that a little pruning each year is less of a shock to the tree than vigorous pruning at intervals of several years. Nature protects wounds by excluding germs of decay and water. This should be done in artificial pruning, especially in the case of all wounds an inch or over in diameter. Paint is valuable for this purpose. In self-pruning, limbs are cut close up to the parent branch. In artificial pruning, the same practise should be observed.